Project Report: Habitability of Planetary Bodies

Lead Team:	***University of Colorado, Boulder***
Project Title:	***Habitability of Planetary Bodies***
Project Investigator:	***Brian Toon***

Project Progress

During the past year we have been very active in proposing new mechanisms to form the river valleys on Mars. These had been attributed to an early greenhouse on Mars. However, we were able to show that such a greenhouse cannot be created with the known materials on Mars (mainly carbon dioxide and water). As part of the Astrobiology project at CU, we have shown instead that impacts of asteroids and comets on Mars may have distributed great sheets of hot melted rock over the planet. Such layers of rock are observed on Mars. This hot material may have then released water from the soil. In this scenario, the planet would only have brief periods of warm temperatures in which to arise, and near surface life would have been killed by the hot rock. (Segura, O. B. Toon, A. Colaprete, and K. Zahnle, 2002, Environmental effects of large impacts on Mars, submitted to Science).

We have also worked on the origins of small streams on Mars. Gullies on steep slopes on Mars seem to be relatively young. We have been exploring terrestrial analogs in order to understand how ground water might make such streams and to calculate what their properties might be on Mars ("Cold Springs in Permafrost on Earth and Mars"−− D. Andersen, W. Pollard, C. McKay, J. Heldmann, Journal of Geophysical Research−Planets, Vol 107, No E3, March 2002).

Finally with a new NAI post−doctoral fellow, Dr. Alex Pavlov, we have begun a series of studies of the early atmosphere of Earth. We are investigating the nature of methane rich atmospheres, the effects of collisions of the solar system with dust clouds in the galaxy, and the nature of terrestrial clouds in an atmosphere without the oxygenated aerosols that are critical to cloud formation today.

Highlights

- We find that the river valley networks on Mars could result from the climatic effects of impacts. Hence the vision of a life friendly moist warm early environment on Mars may be incorrect. Early Mars was

probably very cold, with brief periods of scalding steam atmospheres.

- There are terrestrial analogs to the geologically recent gullies observed on Mars.

Roadmap Objectives

- ***Objective No. 5:*** Linking Planetary Biological Evolution
- ***Objective No. 8:*** Past Present Life on Mars
- ***Objective No. 12:*** Effects of Climate Geology on Habitability

Mission Involvement

*Mission Class**	*Mission Name (for class 1 or 2) OR Concept (for class 3)*	*Type of Involvement***
1	Mars Global Surveyor, Odyssey	Background research

* Mission Class: Select 1 of 3 Mission Class types below to classify your project:
1. Now flying OR Funded & in development (e.g., Mars Odyssey, MER 2003, Kepler)
2. Named mission under study / in development, but not yet funded (e.g., TPF, Mars Lander 2009)
3. Long−lead future mission / societal issues (e.g., far−future Mars or Europa, biomarkers, life definition)

** Type of Involvement = Role / Relationship with Mission
Specify one (or more) of the following: PI, Co−I, Science Team member, planning support, data analysis, background research, instrument/payload development, research or analysis techniques, other (specify).

We have used data from various Mars missions to frame the questions that we are interested in.

Cross Team Collaborations

We have collaborated heavily with Jim Kasting from the Penn State Team, and with Kevin Zahnle and Chris Mckay from the NASA Ames Team.